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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

In cooperation with

BUREAU OF PLANT INDUSTRY

Report of the

ALLEGHENY FOREST EXPERIMENT STATION*

January 1 to December 31, 1936

and

Proposed Program, Fiscal Year 1938

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ALLEGHENY FOREST RESEARCH ADVISORY COUNCIL *

July, 1936

Chairman. Dr. Rodney H. True, head Department of Botany, University of Pennsylvania, Philadelphia, Pa.

Vice-chairman. Dr. J. G. Lipman, director New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Charles G. Berwind, vice-president The Berwind-White Coal Mining Company, Philadelphia, Pa.

F. W. Besley, state forester Department of Forestry, Baltimore, Md.

Dr. J. F. Bogardus, secretary Department of Forests and Waters, Harrisburg, Pa.

Egbert S. Cary, superintendent Pocono Lake Preserve (Pa.), Moorestown, N. J.

Francis R. Cope, Jr., proprietor Woodbourne Dairy and Orchards, Dimock, Pa.

E. O. Ehrhart, forest engineer Armstrong Forest Co., Johnsonburg, Pa.

Prof. J. A. Ferguson, head Department of Forestry, Pennsylvania State College, State College, Pa.

Dr. O. E. Jennings, head Department of Biology, University of Pittsburgh, Pittsburgh, Pa.

Henry W. Leeds, manager Chalfonte-Haddon Hall, Atlantic City, N. J.

Prof. C. A. McCue, dean School of Agriculture, University of Delaware, Newark, Del.

Adolf Muller, proprietor DeKalb Nurseries, Norristown, Pa.

P. G. Platt, Wallingford, Pa. Member Pennsylvania State Sanitary Water Board.

M. B. Saul, counsel The Morris Foundation, Morris Arboretum, Philadelphia, Pa.

Col. Henry W. Shoemaker, McElhattan, Pa. President Altoona (Pa.) Tribune.

J. Spencer Smith, Tenafly, N. J. President New Jersey Board of Commerce and Navigation.

W. S. Taber, state forester State Forestry Department, Dover, Del.

Ezra B. Whitman, engineer Whitman, Requardt and Smith, Baltimore, Md.

H. C. Wiener, president H. C. Wiener Lumber Company, Wilkes-Barre, Pa.

C. P. Wilber, state forester, Department of Conservation and Development, Trenton, N. J.

Abel Wolman, chief engineer State Department of Health, Baltimore, Md.

Secretary. R. D. Forbes, director Allegheny Forest Experiment Station, Philadelphia, Pa.

* Members are appointed by the Secretary, United States Department of Agriculture.

ALLEGHENY FOREST EXPERIMENT STATION

1936

PERMANENT STAFF

FOREST SERVICE

R. D. Forbes	Director
G. L. Schnur	Associate Silviculturist
A. F. Hough	Assistant Silviculturist
O. M. Wood	Assistant Silviculturist
Wm. Mollenhauer Jr.	Assistant Forester
P. E. Ackerman	Senior Forest Ranger
Miss Hazel L. Stiles	Senior Clerk
Mrs. Margaret R. Evans	Senior Stenographer
Miss Hazel V. Loose	Assistant Statistical Clerk

BUREAU OF PLANT INDUSTRY

Dr. L. W. R. Jackson	Assistant Pathologist, in Charge
Dr. K. D. Doak	Assistant Pathologist

TEMPORARY EMPLOYEES*

FOREST SERVICE

A. A. Downs	Junior Forester
Silas Little Jr.	Junior Forester
Emil F. Meyer	Junior Forester
Carl E. Ostrom	Junior Forester
H. W. Turberville	Junior Forester
J. M. vanNieukerken	Assistant Forester
R. P. Broomall	Assistant to Technician, Research Center Branch
Joseph S. Hoffmann	Assistant to Technician, Stone Valley Branch
William O. Nisbet	Assistant to Technician, Lebanon Branch
Luther Maze	Foreman, Kane Branch
C. Niederhof	Field Assistant
Walter Westerfeld	Field Assistant
W. S. Beckley, Jr.	Field Assistant
Konstantin Ogloblin	Field Assistant
Miss Ella Wilkin	Junior Stenographer

Security Wage Workers:
Philadelphia headquarters, 8; Kane Branch, 10; Lebanon Branch, 10; Research Center Branch, 10; and Stone Valley Branch, 22.

BUREAU OF PLANT INDUSTRY

Dr. Bailey Sleeth	Junior Pathologist
Elmer R. Roth	Junior Pathologist
Frank Kaplan	Assistant Scientific Aid
Robert Wean	Assistant Scientific Aid

*Very few employed for entire year.

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Summary of Current Progress

During 1936 a major advance was made in our growing knowledge of the silviculture of the birch-beech-maple-hemlock type. This is a type where the presence of much second growth of excellent appearance has encouraged the generalization that in the absence of fires any method of cutting, no matter how clean, will be followed by satisfactory regeneration. Comprehensive timber stand improvement studies in four young stands averaging 15 years old, supplementing earlier studies in 40-year old timber, demonstrated that even intensive silvicultural treatment cannot cure conditions often produced by improper cutting of the previous growth. The third growth which follows extensive clear cutting of second growth tends to be distinctly inferior in species composition and promise of quality yield.

Four special studies, all but one of relatively short duration, were undertaken in response to requests from public and private agencies for help in solving their forestry problems: jointly with the Eastern Region of the United States Forest Service, an analysis for administrative use of the forest fire statistics of New Jersey; a cooperative survey of the plantations of the Allegheny National Forest and the Armstrong Forest Company; a study of stand improvement in plantations on the Baltimore city watershed, in cooperation with the Maryland Forest Service; and, at the request of the State Forester, a study of controlled burning as a silvicultural tool in southern New Jersey.

Marked progress has been made toward the acquisition and development of an adequate system of branch stations, or centers of field work. Facilities at the Lebanon Branch have been increased by moving to it and improving the small dwelling formerly at Camp Ockanickon. The Kane Branch headquarters have been safeguarded against fire by the erection of a water tower, and are at last connected with a State highway by an all-weather road. Bachelor living quarters and a garage have been built by the Resettlement Administration for our eventual use at the prospective Standing Stone Branch. At the National Agricultural Research Center a tract has been assigned to our use. The State Forester of Maryland has approved our selection of an experimental forest on the Eastern Shore, or Del-Mar-Va peninsula, to be transferred from the Resettlement Administration.

WORK OF THE CALENDAR YEAR 1936

ADMINISTRATION

Finances

An addition of $6,500 to the continuing funds of the Station brought their total to $29,200, or nearly back to the level of the original appropriation for the Station, made in the fiscal year 1928. These are Forest Service funds. The corresponding allotment for our cooperators, the Office of Forest Pathology of the Bureau of Plant Industry at Philadelphia, was $7,975, as compared with $10,000 in 1930.

"Emergency" or temporary funds allotted the Forest Service during the fiscal year 1936 were as follows: from Emergency Conservation Work, $6,643, and from Emergency Relief Administration, $20,424.

Personnel

The increase in regular allotment to the Station will permit the creation of an additional permanent position on the staff, which now consists of six professional or semi-professional men and three clerks. An average of 22 persons have been employed from temporary funds during the year, including 6 office workers of various grades, and 14 laborers or artisans, and 2 supervisors, at field stations. The Bureau of Plant Industry employed from emergency funds 5 persons, chiefly highly trained technicians.

Advisory Council

The enlarged Council appointed in 1935 has been extremely active in the Station's behalf. Well attended meetings were held at Philadelphia in January, and at State College, Pennsylvania, in July. At the January meeting the Council elected Dr. Rodney H. True of the University of Pennsylvania as chairman, Dr. J. G. Lipman as vice-chairman, and Director R. D. Forbes as secretary; it also provided for the creation of two important committees. The first of these, known as the Committee on Coordination of Research, included a few members of the Council, and in addition representatives of every organization in our territory known to be conducting research of its own or to be interested in obtaining the results of research. Twenty-three members of this committee met in a two-day session at Harrisburg in February, and selected from a long list of research projects presented to it by Chairman Forbes twelve which it considered to be of outstanding importance. This list of twelve projects was later considered by the Council's Committee for Stimulation of Research, a much smaller committee consisting exclusively of Council members. The function of this committee was to consider ways and means by which an adequate program of forest research could be carried out in the Station territory; as a starting point, it recommended that 3 major projects be immediately undertaken at the Allegheny Station: timber stand improvement, wildlife in forest management, and forest influences. This report was unanimously adopted at the July meeting of the Advisory Council, which voted to give it suitable publicity. A member of the Council later attended a public hearing

before the Director of the Budget, and urged the consideration of particularly the influences project. Several members of the Council have been in close touch with our research in the woods, and have given extremely valuable advice and help.

Branch Stations

The land purchase program of the Resettlement Administration, and substantial increases in Station payrolls from emergency funds, have made possible notable progress in acquisition and development of experimental forests at branch stations. In August Ranger Ackerman was placed in charge of all ERA work at branch stations, thus relieving the very heavy load of administrative duties which has cut into the research work of Associate Silviculturist Schnur and other members of the technical staff. Supervisors of semi-professional grade are in charge of ERA crews at four of the five experimental forests now acquired or in the process of acquisition.

Lebanon (southern New Jersey)

The inventory cruise of the 540 acres in the Lebanon Experimental Forest was practically completed during the year. Weather observations at paired stations, one in the open and the other in the woods, were continued throughout the year, as were phenological observations on a small scale. A paper which discussed several months' precipitation recorded under various kinds of tree cover at the Camp Ockanickon Experimental Forest was published.

The small field house erected at Camp Ockanickon in 1928 was torn down by an ERA crew, and rebuilt with modern plumbing at the Lebanon Forest headquarters. Minor improvements to the other headquarters buildings were accomplished with ERA labor, and an ERA crew, now of 10 men, has been used to safeguard permanent sample plots against fire and on similar jobs, including manual labor on sample plots.

Kane (northwestern Pennsylvania)

ERA labor has been available for several substantial improvements at the headquarters: remodeling of the interiors of the laboratory building, the ranger's residence, and the staff dwellings; and the erection of a thousand-gallon water tank, with suitable connections to all parts of the headquarters site, for fire protection purposes.

The Civilian Conservation Corps completed in first class shape the main road connecting the headquarters with the paved road from Kane to Russell City.

In March a glaze storm, the worst in the memory of the oldest inhabitant, wrought havoc to some 575 acres of the Kane Forest at higher elevations. Much ERA labor was necessary to open the roads and fire lines, free our fences

from down timber, and put our power line back in commission. The same crew, at times numbering 20 men, completed the actual cutting on the permanent sample plots laid out the previous summer, and extended the weedings to 45 acres of similar forests adjacent. Two acres of young stands were also pruned experimentally.

Stone Valley (central Pennsylvania)

Although the Stone Valley Experimental Forest of about 1,800 acres is still in the hands of the Resettlement Administration, it is being rapidly improved by the Administration for our use. A member of our staff has been in residence at Huntingdon, the Administration's local headquarters, for the greater part of the year, thus assuring very close cooperation between the two agencies. Of a considerable group of field buildings promised us, an extremely pleasing "lodge" and a roomy garage were completed during the year. These buildings, and an excellent approach road from the nearest highway, illustrate the value of competent architectural and landscaping advice, which our other field installations have lacked because of thepiecemeal construction necessitated by meager and uncertain funds. A local electric light plant, and a sewerage and water plant, will be next constructed, followed by a resident superintendent's residence and a field laboratory.

ERA labor has been employed in re-opening woods roads through the tract, and providing them with more adequate drainage. Fifty-foot strips have been cleared of inflammable material along the more important of these roads, and water for drinking purposes and possibly fire protection has been developed.

During the residence of the staff member on or near the tract a start was made in the collection of phenological data and observations of wildlife, the latter of particular value on a tract where we hope zoological studies can be undertaken in the near future.

National Agricultural Research Center (Western Shore of Maryland)

All of the land at the Center is now actually in the hands of the government, through purchase by the Resettlement Administration. At a meeting in March of the bureaus of the Department of Agriculture interested in the Center a map was displayed showing the tracts tentatively assigned to each Bureau; the Secretary's formal approval of these allocations has not yet been announced. Although the building site on the Forest Service tract has been mapped in detail, and an extremely pleasing layout of buildings has been designed, neither the Resettlement Administration nor the Forest Service has yet had the funds for any construction. A little ERA labor has therefore been employed in making usable for office purposes one of the frame houses, centrally located, on the tract. Crews, up to 20 men in size, have fireproofed roadside strips, opened old roads, and disposed of highly inflammable logging slash on 200 acres recently cut over. They have also mapped the major roads, and posted the entire boundary of the tracts assigned to Forest Service use. Surplus stock from a nearby CCC nursery has been used in a ten-acre experimental planting of loblolly pine, variously spaced.

Eastern Shore (Del-Mar-Va Peninsula)

A tract of about a thousand acres, chiefly of pine, but including some hardwood, has been selected from several tracts on the Eastern Shore of Maryland now in the hands of the Resettlement Administration, and the State Forester has given tentative consent to its direct transfer to the Forest Service for experimental purposes. The tract is located about 3 miles south of the village of Pittsville, Maryland, not far from the other Resettlement Administration purchases which will be turned over to the State Forest Service. Considerable timber stand improvement work has already been done on it by the Resettlement Administration, which adds rather than detracts from its value for research.

This experimental forest is less than 10 miles south of the Delaware-Maryland line, and in elevation and forest composition should be typical of a large portion of both States. A branch station on the Eastern Shore has for some years been definitely on the Station's program of physical development. The sample plots established by the Forest Service in 1906, in a study of loblolly pine, and periodically re-measured by the Maryland and Federal forest services in cooperation, lie within 20 miles of this tract. An excellent start has therefore been made in the field of research to be covered from this branch station.

Cooperation and Public Relations

The University of Pennsylvania has increased our headquarters facilities in Philadelphia by allotting to us four additional rooms in a former dwelling house in the immediate vicinity of the present headquarters. ERA labor has been used in putting these rooms in shape for use, and a difficult problem of crowding has thus been temporarily relieved.

An immediate benefit from the above arrangement has been the continued residence at Philadelphia of the Bureau of Plant Industry pathologists engaged in the study of rot in sprout oaks. Daily contact between men working on different phases of the same problem, such as silviculture and pathology, in a forest region, never fails to stimulate both. A series of seminars for the discussion of mutual problems, arranged by Dr. Jackson, was not only intrinsically valuable, but has provided closer working relations between the technical men. The Forest Service has welcomed the B.P.I. men at our Kane Experimental Forest this year, and is much gratified at the extensive use which they have made of it for permanent sample plot work.

Excellent contacts in field and office with our sister experiment stations adjacent have resulted from the Northeastern Station's extension of its fire insurance study into our territory, and its invitation to attend a "Show Me" trip to nurseries and plantations in central New York; from Schnur's attendance at a seminar on statistical methods at Bent Creek (Appalachian Station); and from an exchange of visits between Hough and Associate Silviculturist Buell of the Appalachian Station, in a study of weeding in the northern hardwood-hemlock type of our respective territories.

Cooperation with the administrative organization of the Forest

Service in the Allegheny territory (Region 7) has been increasingly effective. This has included not simply an office discussion of common problems, and special consideration from the Region in such matters as the assignment of CCC student enrollees of particular promise to work with the Station, but has taken concrete form on two projects later described in detail: an analysis of forest fire statistics in New Jersey and a survey of plantations on the Allegheny National Forest.

Our extremely profitable relationships with the Resettlement Administration have been covered in the discussion of branch stations. The Station has also had increasing contact with the Soil Conservation Service, another Bureau of the Department of Agriculture, at several points in the field and in the office. One of the highlights of the Advisory Council meeting in July was a morning's visit to the soil erosion plot of the Soil Conservation Service at State College, Pennsylvania. Research data and informal advice have been furnished the Service on several occasions.

Research workers from Pennsylvania State College visited the Kane Experimental Forest for several days. At the Stone Valley Branch Station, the establishment of which was suggested by the College, a foundation has been laid for future cooperation in field work.

The Station's efforts to participate broadly in the development of forestry in all its aspects throughout the territory have been particularly fruitful during the past year. The entire technical staff has taken an active part in the affairs of the Allegheny Section of the Society of American Foresters; Schnur was secretary of the Section, Hough was chairman of the Type Committee, and Wood a member of the Committee on Wildlife in Forest Management. Forbes was representative of the Section in several matters of major importance; the chief of these has been the formation and conduct of the Pennsylvania Federation for the Merit System, a league of professional and lay organizations interested in obtaining a State-wide civil service law for Pennsylvania. He is a member of the Executive Committee of the League, which has employed a paid secretary, prepared a report on civil service for the Governor of Pennsylvania, and drafted a model civil service law.

Close contact, through the Pennsylvania Forestry Association and the Allegheny Section, has been maintained with the wildlife interests of our territory. Forbes has represented both organizations in the movement to establish a Pennsylvania unit of the General Wildlife Federation, and has established excellent relations with the extremely active Board of Game Commissioners of Pennsylvania.

In anticipation of a request for cooperation which may yet materialize, Wood drew up for the Agricultural Adjustment Administrations of our four States (ACP, as now constituted) specifications for planting by farmers in the major forest types of the Station territory.

Cooperationwith agencies interested in water conservation has taken varied form during the year. The Station furnished the water consultants of the Water Resources Committee of the National Resources Committee data on the condition of watershed vegetation for several of our major drainages,

and Forbes presented a paper on forest influences before the 4-States Section of the American Water Works Association, of which Mr. Whitman of the Advisory Council is now chairman. Forbes has also been in touch with the newly-formed interstate committee for cooperation on the Delaware River watershed, an organization with headquarters in Philadelphia. The president of the United States Flood Control Federation, who is also chairman of the forestry committee of the Pennsylvania senate, spent a day on the Allegheny National Forest at our invitation.

Members of the staff have appeared on the programs of a botanical society at the Morris Arboretum; of the Philadelphia Society for Promoting Agriculture; of the Philadelphia League of Women Voters (on civil service reform) and the Pennsylvania Engineers Club (on forest influences); and of a considerable number of local organizations, including service clubs, high school vocational conferences, local foresters' meetings, garden clubs, etc. The Station also participated in the radio program of the Philadelphia Federal Business Association.

RESEARCH IN SILVICS

The silvical and silvicultural research of the Station during 1936 was divided between the following projects, arranged in approximate order of importance. The names following each project are of the project leader or leaders.

Management, Beech-birch-maple-hemlock (Project M-1)(R.D.Forbes and A.F.Hough)

The beech-birch-maple-hemlock type covers about 4 1/2 million acres of forest land in the Station territory, chiefly in Pennsylvania, where it was once the backbone of a lumber industry exceeding that of any State. It is still the source of most of the lumber produced in the Allegheny region, and supports other substantial forest industries, notably paper pulp and chemicals derived from wood. As the home of an abundant and diversified wild life it attracts hunters, fishermen, and out-of-doors enthusiasts in large numbers. Covering the mountains and plateaus at the headwaters of such major streams as the Delaware, Susquehanna, and Ohio Rivers, it is of outstanding importance in watershed management, particularly for flood control. It is the site of the one National Forest in the Station territory, and of several State Forests. Cutting and fire have reduced large areas of it to stands of non-commercial species which present grave problems in forest restoration. Methods of silvicultural management which will bring the type to highest usefulness for wood production, recreation, and watershed protection have been little explored. The Station therefore concentrates here the greater part of its research.

Ecology of unmanaged stands

East Tionesta Virgin Forest Study. Stands of virgin hardwoods-hemlock being logged in 1934 and 1935 were sampled by 10 1-acre plots located on both sides of East Tionesta Creek. The object is to reconstruct from ages of the trees and other evidence the history and development of such stands, and to determine the silvical requirements of species in them, as a guide to correct silvicultural management of the present second- and third-growth forests of the type.

Age counts, particularly of suppressed trees, were known to be too difficult to attempt in the field. Basal sections have been therefore sawn from all sound trees 0.6" d.b.h. and larger on the 10 plots, transported 20 or more miles to the Kane Branch Station, labeled, dried, broken pieces glued, and later brought to the Philadelphia office by truck for careful counting under the microscope. All sections have been prepared for counting on an electrically-driven sanding, grinding, and buffing machine; without such preparation accurate age determinations would be impossible. It was found essential to secure V cuts (pith to periphery) or sections at the root collar for correct total age counts, but sections at stump height were found more suitable for studies of radial growth and response to competition. This more than doubled the amount of field work originally planned for the study.

The accomplishments on this study during 1936 are in the nature

of progress rather than final results.

(1) Field work of sawing sections on all plots was completed, the stumps on plots #4, 8, 9, and 10 being butted off by a CCC crew of 20 men, to obtain sections at ground level. In all, about 1,100 sections were sawn in 1936. Records and all sections in the office were carefully checked to determine those missing and search was made in the field to locate and resaw such sections on all plots.

(2) Surfacing and counting of 555 basal sections cut in 1935 was done by an ERA crew of 3 persons. Check counts were made on all hemlock V cuts sawn in 1934. The 1100 sections cut in 1936 were brought to Philadelphia in September, and about 400 were surfaced and counted prior to January 1, 1937.

(3) Summaries were made of seed bed conditions for each tree, noted in 1934, and of reproduction quadrat data for each plot. Stem maps of all plots were bound in an atlas, and age counts are being recorded currently.

(4) Three articles giving the results of work in East Tionesta, as well as in the Hearts Content and Cook State Forest virgin areas, were published in Ecology.

Dying of Hemlock. Technical Note #9 on the dying of hemlock and other species on the Allegheny National Forest was published in January, 1936. Alarm felt by local people over the dying of hemlock in virgin forests near Sheffield, Pennsylvania, prompted the Regional Office of the Forest Service to re-cruise the Tionesta tract to determine the extent and severity of hemlock losses. The Station participated by contributing the services of junior foresters Ostrom and Turberville. Line plots established in 1934 were re-tallied, and 12 per cent of the total volume present in 1934 was found to have died in the last 2 years. Addition of growth for the period reduced this figure to a net loss of about 9 per cent of the total board foot volume. It appears that the losses are less for 1936 than for 1935, and that barring continued drought, future losses should decrease.

Glaze Damage, Kane Experimental Forest. On March 17-19, 1936 the worst ice storm ever recalled by the oldest local residents played havoc with stands on the Kane Experimental Forest. With the aid of CCC student enrollees a 2.6 per cent cruise was made of 1675 acres during the following summer to determine the local extent and amount of damage done by this catastrophe. The cruise data have been tabulated by type of injury for each age class, species, d.b.h., and 100-foot elevation classes on the experimental forest. Data on the weather conditions during this storm, extent of damaged area in Pennsylvania and New York State (6,000,000 acres), and character of the damage, were obtained by correspondence and from current literature. A private survey of ice-damaged lands of the Armstrong Forest Company in McKean, Elk, and Cameron counties was also made by C. P. Shull of the Allegheny National

Forest, assisted by Hough. A report on the silvicultural aspects of this storm is being written for the Journal of Forestry, and a second article on the weather phenomena for the Monthly Weather Review.

Natural Reproduction as Influenced by Deer and Rabbit Damage, Kane Forest. Natural reproduction on 4 fenced and 4 unprotected 1/2-acre plots was studied to determine the amount, location, and type of injuries caused by deer and rabbits. On the unprotected plots in the old-growth stands damage by deer was only 0.1 per cent and by rabbits only 1 per cent of the total number of seedlings present; in the two second-growth stands 26 - 46 per cent of the reproduction was damaged by deer (not seriously as a rule), and 5 - 16 per cent damaged by rabbits. An open third-growth stand in a frost pocket was 20 per cent damaged by deer and 23 per cent by rabbits. Black cherry, hemlock, and red maple were the species most frequently browsed by deer, while rabbits seem to show a preference for red maple and a dislike for hemlock. The ultimate effect of the damage to natural reproduction cannot be judged until remeasurements are made in the future.

Cherry Germination Studies. Germination of black and pin cherry seed sown in rodent proof seed boxes was studied during the field season. Most of this seed was ripe when collected, but some was only partially ripe. In general germination was poor with the exception of two samples of partly-ripened seed which were placed in a glass jar with consequent rotting and fermentation of the pulp. It is possible this process ripened the green seed, but heated and made dormant seed already ripe. Removal of the pulp by washing gave better germination than leaving the pulp to dry on the seed coat. The field tests were supplemented by greenhouse tests, in which Dr. Doak used some of the black cherry seed to determine the influence of seed coat sterilization and cold treatments on germination. Alcohol was used to remove the dried pulp, and was followed by sulphuric acid of 9 and 18 per cent concentration; germination of 0 to 4 and 0 to 9 per cent, respectively, resulted in open sand flats exposed to the weather. Chloramine used for 1/2-hour, 1 hour, and 1-1/2 hours, gave no germination. In sterile cultures of moist agar the foregoing treatments applied to 150 seed followed by cold treatment in a refrigerator resulted in starting germination of only 4 seed. The majority of cultures were contaminated by a mold common to all black cherry seed which in some cases did not appear for months because embedded in the sutures of the seed coat. Whether this mold hampers germination is yet to be determined.

Stand Improvement Cuttings.

Weeding study, Kane Forest. The major object of this study is to determine the effect of weedings on the growth and quality of selected crop trees in stands 10 to 20 years old, and on the stands as a whole. In the future it is planned to thin half of the weeded plots and half of the check plots, in order to determine the efficiency of deferring treatment until the cut trees are salable, in contrast with the practice of early weeding, and of weeding plus later thinning.

Five junior foresters and 10 CCC enrollees assisted Hough in the technical work; actual cutting was done by an ERA crew of 10 men. Four randomized blocks of 4.8 acres each, and containing twelve 1/10-acre plots, were laid out in four separate stands of young growth. Two of these stands had originated after logging of second-growth 13 years ago, and two after cutting of old growth 13 and 18 years ago. On these 4 blocks three degrees of weeding - light, heavy, and intermediate (or silvicultural) - were applied to release selected crop trees. Each treated plot, picked at random, has beside it a check plot similarly marked but not actually treated. The effect of the light weeding was to remove 15 per cent of the total number of trees; of the silvicultural weeding, 24 per cent; and of the heavy weeding, 30 per cent.

Detailed crop-tree records have been made to study the response of various species to the three treatments, and the response of the stands to these treatments is being followed by means of plot tallies. A limited number of 1/10-acre plots was intensively studied to secure data on the distance and size of the weed trees and "trainers" surrounding each crop tree. All data were compiled, and an establishment report largely written. Work on this study has plainly shown that weeding is not a cure-all for inadequate crop tree stocking and poor composition; the problem of securing good reproduction remains that of applying proper methods of final cutting.

Bear Tree Plots, Kane Forest. The volume of all trees has been computed for the 8 acres of thinning plots established in 1933 to study methods of stand improvement in 40-year-old second growth. Atlas sheets to record the tree measurements have been made out for each plot. A manuscript describing the occurrence of defects in trees on these plots, and on the Kane Experimental Forest as a whole, has been written in rough draft.

Reproduction Cuttings

Little Arnot Plots. The cubic foot volume of all trees on the 4 acres of plots on Little Arnot Creek was computed to show the volume present before cutting in 1927, amount removed and left after logging, mortality and growth during the five-year period, and volume present in 1932. Technical Note #10 on epicormic branching was distributed in January. Since these plots will be remeasured for the second time in the fall of 1937 it was decided to postpone writing of a progress report until data from this 10-year re-examination may be included. An article on the results of six years' semi-annual examination of mapped reproduction quadrats on these plots was written and submitted to the Journal of Forestry for publication.

Management, Oak-Pine (Project M-3) (O. M. Wood)

The oak-pine type of the Coastal Plain covers about 4,000,000 acres in the territory of the Station. It includes not only the highly productive and intensively used loblolly pine-sweet gum forest of southern Delaware and the Eastern Shore of Maryland, but also the generally impoverished and long abused Virginia pine-oak and pitch pine-oak forests of the Western Shore of Maryland and southern New Jersey. The south Jersey forest of about 1-1/2 million acres of nearly continuous woodland is probably closer to great centers of population than any forest of like area in the United States; within 75 miles of it live 12,000,000 people in 4 States. Even in its present degraded condition, resulting from a century of over-cutting and periodic fires, it furnishes recreation to hunters, fishermen, and outdoor recreationists in large numbers; produces some wood of certain species of high technical quality; and is believed locally to exercise a favorable influence on south Jersey's small but extremely valuable streams. Brought to full productivity by proper silvicultural management, the south Jersey forest has enormous promise. Methods of rehabilitating it as part of the oak-pine type have been a major research project of the Station.

Reproduction of the Principal Species

From seed. Phenological observations were continued for a number of the principal species on the Lebanon Forest. Seed traps were set up to determine the time of shortleaf pine seed dispersal. Shortleaf pine seed was collected for sowing on treated plots.

All oak seedlings remaining in the beds at Camp Ockanickon were excavated, measured, and weighed dry. Height growth of oak seedlings in the Lebanon beds was remeasured and damage from a late spring frost appraised.

A manuscript based on data accumulated since this project was undertaken in 1928, and describing the factors responsible for the general failure of oak reproduction in southern New Jersey, was prepared and was being revised at the end of the year to include 1936 field data.

In anticipation of a fair crop of shortleaf pine seed, another Latin square was laid out on the Lebanon Forest in which there are three replications of three different methods of mechanically changing the seed bed and 4 control plots. In one series of plots the turf was dug up, in another the turf was "scalped" off and in another only the litter was removed, all work being done by CCC enrollees. The plots are 1/10 acre in area and were laid out in a stand of 13-year old sprout oak overtopped by old shortleaf pines averaging about 13 pines, 4 inches d.b.h. and up, per plot. In the center of each plot a 3'x6' rodent proof seed bed was placed and artifically sown with 200 shortleaf pine seeds. An equal unprotected area adjacent was seeded in a like manner. Ten mil-acre quadrats for future study of natural reproduction were located within each plot.

A study was undertaken of the use of fire, under control, as a silvicultural agent, i.e. as an aid to natural reproduction, particularly seedlings. This phase of the project originated with the State Forester of New Jersey. The Station, the CCC, and the New Jersey Agricultural Experiment Station will cooperate in experiments designed to show the effect on seedbed, on competition of other vegetation with seedlings, and all other advantages and disadvantages of controlled burning. With the State Forester, a plan was drawn up which provides for 8 burning treatments, each replicated once, on 5-acre blocks; a total of 80 acres, including controls, is thus treated. One pair of 5-acre blocks will be burned annually, another pair every second year, another every third, another every fourth, another every fifth, another every tenth, and another every fifteenth year. The eighth pair of 5-acre blocks will be kept unburned as controls. All except the controls will be burned for the first time in 1937. Timber stand, reproduction, and shrubby and herbaceous vegetation will be recorded before and after burning on ten 1/20-acre plots in each block. Soil and litter samples will also be collected. Each 5-acre block will be surrounded by a fire line. Should heavy reproduction of pine become established on any block, that block will be subdivided by a fire line into two 2-1/2-acre blocks, one of which will be burned according to schedule, while the other will be thenceforth protected. Two quadrats, one protected from animals and the other not, will be artifically seeded on each of the 160 plots.

During the summer several field conferences were held with representatives of the State Forester to select a site for the experiment. A preliminary reconnaissance of this area was made to determine its suitability, and a traverse board map was made of the roads surrounding it. This map and the plot design were turned over to the Superintendent of CCC Camp S-69, for the survey of the block boundaries, and construction of all fire lines by the CCC.

From sprouts. Data on the persistence of stems per sprout clump after 13 years were summarized fromthe stem maps of the 16 stand-conversion plots. The first season's growth of sprouts under three degrees of thinning on the same plots was measured in the fall of 1936.

Conversion from Coppice to High Forest

From the stem maps of the 16-plot Latin square laid out in 1935 basal areas were summarized by 1/64 acre sub-plots. Height and diameter data were grouped and curved. A topographic and profile map of all plots, also a map showing location of pine seed trees, were made. The actual cutting of marked trees on all plots was completed, and checked against the marking onthe stem maps. Sixteen 4'x4' seed traps were made, and one was placed in the center of each of the 16 plots.

Special Studies, New Jersey Forest Fire Analyses (Project Pf-Special) (G. Luther Schnur)

An analysis of the New Jersey forest fire records for the past 5 years was started in August in cooperation with Region 7 of the Forest Service and the New Jersey Forest Fire Service. The preliminary work completed includes a map for each of the past five years showing location and size-class of all fires; charts for the past ten years showing annual number, area, size, and cost of fires; and more detailed analysis of the 1600 fires in 1931. The latter includes acreage burned by forest types and administrative divisions, elapsed time-size and elapsed time-cost analyses, also, diagrams of number of fires and acreage burned by months and 10-day periods. An analysis of the number of days since 0.1 inch precipitation was also made for the five-year period.

Although the Region's immediate requirements have been met by the work already done, the Station plans to intensify its analysis of the 5-year records. This entails punching records for some 6000 fires, so that mechanical sorting and tabulating equipment can be used.

Special Studies, E.C.W. Pruning and Thinning (Project Mt-2, Special) (G. Luther Schnur and Wm. Mollenhauer Jr.)

This special E.C.W. study in cooperation with the Maryland Department of Forestry was undertaken in 1936 at the urgent request of the State Forester. The great expansion in forest planting in recent years, and the need for improvement cuttings in older plantations, should make this study particularly valuable to both governmental and private agencies that may be planning pruning or thinning of young growth either natural or planted. A 23-year old plantation of mixed white pine and tulip poplar on the Baltimore watershed at Loch Raven is the scene of the present experiment. The plots have been selected, laid out, and the preliminary measurements obtained.

Forest Planting, Beech-Birch-Maple-Hemlock (Project Fp-1) (A. F. Hough, Station; J. E. Hetzel, Allegheny N. F.)

Work during 1936 on this project consisted of cooperation with the Allegheny National Forest and the Armstrong Forest Company in a survey of the older of their 8000 acres of plantations. These were chiefly in aspen-fire cherry stands, with a few old fields. Under working plans drawn up jointly, Hetzel tallied over 1000 temporary plots of 20 trees (or fail spots) each in plantations of several species - Norway pine and Norway spruce chiefly - on a wide variety of sites. Mortality, height and vigor of surviving seedlings, and detailed plot descriptions were recorded in code in the field, greatly facilitating later punch-card analysis. Hetzel came to Philadelphia for analysis of the data and preparation of his report.

Mensuration, Oak-Pine (Project ME-3) (G. Luther Schnur)

Schnur and Wood completed the seventh 5-year remeasurement of the 13 remaining loblolly pine sample plots on the Eastern Shore of Maryland.

Mr. E. M. Simmons' article on a basal area-ratio method of site classification was revised following criticism and transmitted to the Journal of Forestry for publication.

Fire damage, oak-pine (Project Pf-3) (O. M. Wood)

The one burned plot remaining of those established in 1930 was remeasured along with an adjacent control plot, and data used in Technical Note 13, "First year losses after a fire may not represent total mortality."

The effects of fire on the present stand, including advance reproduction, and on the site, will be studied on the same series of controlled-burning plots used in oak-pine management study (see first paragraph on page 12). Plans for this joint study with the New Jersey forest service were drawn up, a suitable area selected, and the plot boundaries established by the C.C.C.

Special Studies, 1930 Drought (Project Pw-Special) (G. Luther Schnur)

This special cooperative study with the Pennsylvania State College came to a close during the year with the publication, by the College, of the bulletin "Effect of Drought on Oak Forests". The final proof reading and writing of the abstract was done by the Station.

Mensuration, Oaks (Project ME-2) (G. Luther Schnur)

The Northeastern Region of the Soil Conservation Service borrowed the Station's stencils of the oak volume tables in order to make sufficient copies for distribution to their field units where they are in constant demand on demonstration projects.

PLAN OF WORK FOR THE FISCAL YEAR 1938

Finances

The Bureau of the Budget has approved no increase in the continuing funds of the Station for the fiscal year 1938, beginning July 1, 1937. The Station's plans for the year are therefore based on an allotment of "regular" funds of $29,200, or the same allotment as in the fiscal year 1937. This sum permits the maintenance of a staff of 5 technicians, including the director, and 4 persons in other grades.

It is assumed that the temporary allotment now received from Emergency Conservation Work will be continued, permitting the employment of 4 Junior Foresters, or 3 Junior Foresters and an additional clerk. At least until July 1 the Station may also count on assignment to the Station by the CCC of 10 Junior Assistants to Technicians; these men have no technical training, but are prospective students of forestry. Temporary ERA funds should continue, although in diminishing amount, for several months, and will permit of continued progress in the development of our experimental forests. ERA employees will also supplement the clerical staff, and will furnish badly-needed help in drafting, but can con-

tribute in only minor degree to the progress of actual research. Even a greatly curtailed ERA program should permit us to assign to the experimental forests the small crews necessary to their protection from fire and depredation, and to maintenance of the weather records.

Branch Stations

As indicated in the previous paragraph, physical development of existing branch stations will be pushed with emergency labor, but lack of materials will probably prevent construction of any major improvement.

Every effort will be made to construct, as part of our regular set-up of meteorological instruments at the Kane Branch, stream gauges and settling basins (for silt measurement) on a few streams. These streams will if possible include two which drain the Tionesta virgin area, as well as those which drain second growth birch-beech-maple-hemlock and aspen-fire cherry areas on the Kane Forest. Installation of an adequate system of rain and snow gauges on these watersheds must await funds for forest influences studies.

Observation of frost penetration and soil moisture conditions will be continued at all branches as long as labor is available for the purpose.

Extensive sanitation cuttings will be made on those portions of the Kane Forest severely damaged by the glaze storm of March, 1936. Six or seven thousand cords of wood and a small quantity of saw logs will be sold on the stump to local pulp, chemical wood, and other wood-using industries. Very careful supervision will be necessary to keep logging damage to a minimum. The job is likely to take two years.

Final arrangements will be made jointly with the Regional Forester for the administration of the Tionesta virgin area, now that title has passed to the United States. The Station will apply to the Allegheny Forest for formal recognition of the research status of the permanent sample plots on Little Arnot Creek, and possibly other areas within the Forest, as adjuncts of the Kane Branch.

Confirmation of Forest Service tenure at the National Agricultural Research Centre at Beltsville, Maryland, and the erection of buildings adequate to make this Branch a becoming illustration of Forest Service research, will be the Station's most important administrative objective of the year. The land here is actually in Federal hands, and other bureaus of the Department, suitably housed, are already actively at work on their research programs. The proposal of the National Resources Committee to create a "model demonstration forest management area," or possibly a "park-forest", on 35,000 adjacent acres of land now in private ownership between Washington, Baltimore, and Annapolis, adds to the urgency of work at the N. A. R. C.

Transfer by the Resettlement Administration direct to the Forest Service of the projected experimental forests in Standing Stone Valley, Pennsylvania, and on the Eastern Shore of Maryland, we hope can be consummated within the year. Pending this transfer the Resettlement Administration plans to continue the improvement of these tracts by the erection of

simple field buildings on the Maryland tract, and completion of the building program long outlined in Pennsylvania. Road development, fire protection, and other improvements will be pushed by our ERA crews, under the centralized direction of Ackerman.

RESEARCH IN SILVICS

A year ago it was planned to undertake during the current fiscal year one new major project - management of oaks, and to shift the emphasis in the work at the Lebanon Branch Station in southern New Jersey from the management project to the fire damage project. Unexpected demands upon the Station for research in special fields have made it impossible to undertake the new project, and new circumstances have maintained the emphasis in the south Jersey work on management problems. Particularly in view of the heavy demands which will unquestionably be made upon the Station by the Departmental surveys of watersheds under the Flood Control Act of 1936, work on the oak management project will still have to be exploratory in character, or conducted on a strictly temporary basis.

The major innovation proposed for the coming fiscal year is resumption by the Forest Service of its cooperation with the Bureau of Plant Industry in the mycorrhiza project. Work on this project by Dr. Doak of the Bureau of Plant Industry has reached a point where present personnel and existing field facilities make active participation in this project again possible to the Forest Service, and the intrinsic importance of the mycorrhiza work dictates renewal of our participation. Details are given later.

A second innovation of potential importance in the 1938 program is a special administrative study of the New Jersey forest fire statistics for the last 5 years. This is a temporary job, to be completed within the fiscal year.

Progress on going projects will be in the form of manuscripts for publication rather than large increases in the number of permanent plots established at branch stations. Every advantage will be taken of technical and semi-technical assistance provided by temporary funds (chiefly ECW) to free the permanent members of the staff for manuscript preparation.

Management, Birch-Beech-Maple-Hemlock (Project M-1)

Major jobs, in the order of importance, to be undertaken by Forbes, Hough, Ostrom, and a crew of 6 or 8 student assistants (field season) or junior assistants to technician (presumably 6-months' employment), are as follows:

1. Completion, from data obtained in the thinning, weeding, and other studies on the Kane Forest, of two or three articles on the silviculture of the type, for the Journal of Forestry. These cover the defects characteristic of second and third growth, methods of timber stand improvement, and the effect of repeated clear cutting on natural regeneration.

2. Completion of the manuscript on the virgin forest of the Northern Allegheny Plateau, including the result of the sample plot work in the Tionesta area. Data obtained in the earlier extensive surveys of the northern hardwoods-hemlock forest of northern Pennsylvania have already been incorporated in a paper now two-thirds written. They will be complemented by the much more detailed information from the Tionesta area. Age counts of the last of the Tionesta tree sections, obtained in 1936, are practically complete, and checks are now being made of the material earlier counted. Stem maps are ready except for the insertion of the ages of the trees, and other plot data have been summarized and tabulated. Interpretation of this information, its incorporation in the paper already partly prepared, and completion of the latter, will be given precedence over all field work, and should be accomplished by August 1. The resulting manuscript we hope will be acceptable as an Ecology Monograph.

3. Final draft of two articles, one for the Monthly Weather Review, the other for the Journal of Forestry, on damage by the glaze storm of March, 1936; preparation of a Technical Note from the establishment report on the deer- and rabbit-proof exclosures at Kane.

4. The 10-year remeasurement, at the end of the growing season, of the reproduction cutting plots on Little Arnot Creek, and the preparation of a progress report for publication. If possible the study will be extended to include some of the National Forest cutting adjacent, in which if conditions justify and time permits, some supplementary permanent sample plots may be laid out.

5. Remeasurement of the 16 permanent yield plots on the Kane Experimental Forest, established 5 years ago. These measurements also should be made at the end of the growing season.

6. Reexamination of the 8 acres of thinning plots established on the Kane Forest in 1934, to determine whether thinning of the stand increased the damage from the glaze storm of March, 1936.

7. Reexamination of the exclosure plots on the Kane Forest, in the study of reproduction as effected by deer and rabbits.

A careful review of cutting practices now in effect on the Allegheny National Forest is planned, as a preliminary to future studies of reproduction. It might desirably be expanded to include ordinary commercial cutting in the type. Should time be available, a new reproduction study will be undertaken as a result of the sanitation cuttings planned in the glaze-damaged stand on the Kane Forest. Some of the damaged area will be cut clean, and the remainder selectively, or partially, cut. Although the oldest of the stands to be cut contain only a small amount of advanced reproduction, some opportunity is offered for studies of both seedling and sprout reproduction.

Management, Oak-Pine (Project M-3)

The controlled burning investigation in southern New Jersey which was proposed as a fire damage project in last year's report was, on more careful

consideration, largely incorporated in the management study. That is, major emphasis is now placed on fire as a silvicultural tool in promoting natural regeneration, particularly of pine. Possible improvement of the seed bed, temporary release of plant food, and reduction of competition from secondary vegetation, will be studied. The occurrence of a fair seed year for shortleaf pine in 1936 gave an unexpected opportunity to study natural reproduction of this species. These two circumstances have maintained the management project in the oak-pine type among our major projects, in spite of the sharp curtailment in the work with oaks.

The following work, listed in the order of priority, will take about half of the time of Wood, and the full time of Little:

1. Completion by Wood of his manuscript summarizing several years' work on the factors affecting natural reproduction of oak in southern New Jersey.

2. Re-tally of shortleaf pine and other reproduction on the stand conversion, seed bed preparation, and controlled burning plots, and preparation of a progress report, for publication if the data warrant it.

3. Preparation of several short technical papers from data already in hand or incorporated in establishment report, now in preparation, for the stand conversion and seed bed preparation studies. The most important of these will deal with sprouting of hardwoods, particularly as affected by different types of cutting.

4. Out-planting of the more vigorous seedlings of oak raised in the seed bed at the Lebanon headquarters. These will be planted in the isolation strip of the stand-conversion plot, where, although not in the open, they will be protected from excessive competition by thinning of the overstory.

Mycorrhiza (Project Pd-Mycorrhiza)

The mycorrhiza project was undertaken at Philadelphia in 1930 as a joint project with the Office of Forest Pathology, Bureau of Plant Industry. Each Bureau assigned 1 man to it. When the Forest Service representative resigned in 1932 the Economy Act prevented our replacing him, and Forest Service cooperation has since then been confined to furnishing laboratory facilities and a very limited amount of temporary assistance. The B.P.I. representative, Dr. Doak, believes that inoculation of nursery beds with mycorrhizal fungi is a logical next step in the investigation, and the Bureau has strongly urged the resumption of our cooperation on this phase. Now that the mycorrhiza research is leading directly into the field of artificial forestation, the following circumstances justify our sacrificing progress in other work in order to make this once more a major Forest Service project:

1. Artificial forestation has long been a major silvicultural activity in the Station territory, both on public and private land.

2. The results so far obtained from a large program of planting have been on the whole very discouraging. In 1928 a check-up by the Pennsylvania Department of Forests and Waters of nearly 7 million trees planted on private land showed that the average percentage of survival was only 39 per cent; last year's cooperative study of plantations by the Allegheny National Forest and the Armstrong Forest Company indicate a survival of 34 per cent.

3. Several million acres of degenerate forest types in the Station territory, including aspen-fire cherry and scrub oak, appear likely to require planting if they are to be re-habilitated within a reasonable period. Such types present an even more difficult planting problem than most of the old fields comprising the bulk of the private land previously planted, and call for superior planting stock and every encouragement which can be offered to development of the planted trees.

Plans for the inoculation studies, as outlined by Doak, would concentrate the work for at least the first two years at the Lebanon Branch Station, where, on ground not previously used for this purpose, a small nursery can be established and inexpensively equipped with a sprinkler system, and where laboratory facilities are immediately at hand. A series of 6 beds, approximately 21 feet square, will be laid out, each containing sixteen 4 x 4-foot experimental plots. Seed of two species of major importance to artificial forestation in south Jersey, probably pitch and shortleaf pines, will be sown, and half of the plots will be inoculated with soil fungi known from previous experimentation to form mycorrhizae on the roots of these pines. Two of the large beds will be used to compare the behavior of seedlings under 1/2 and 1/4 shade; two to compare the effect of organic and inorganic nitrogenous fertilizers; and two to compare the effect of organic and inorganic fertilizers supplying other elements essential to seedling development. Some seedlings will be removed from the plots about 4 times during the season, at 3-week intervals, and root cultures will be made immediately to re-isolate the fungi used in their inoculation and to identify other fungi native to the site. The number of mycorrhizal short roots will be counted currently, or the material will be preserved for the purpose. During the first season this set-up will take about half the time of the Forest Service representative, and in the second season, due to the increased size of the seedling root systems, the full time.

The seedlings will remain in the nursery bed for two years, and those not removed for analysis in the course of the experiment will be out-planted for further observation.

With the experience gained at the Lebanon Branch, it will be possible to expand the work later to other branch stations, with other species appropriate to them. The advantages of beginning work at a branch only a little over an hour's distance from the Philadelphia headquarters are obvious. Moreover, past experience leads us to expect that graduate students of the University of Pennsylvania may become interested in specific phases of the work, and can be counted upon for worthwhile technical contributions to the study.

Wood will be assigned to this study, and owing to the location of the experiment on the Lebanon Forest he can maintain contact with the M-3 project even after the mycorrhiza work absorbs his full time.

Special Studies, New Jersey Forest Fire Analyses (Project Pf-Special)

Whether the very large amount of time and effort required for a statistical analysis of forest fire records is justified by the practical information to be obtained for administrative use can be determined only by trial. Completion of the New Jersey analyses is therefore highly desirable, and warrants the assignment of a man of junior forester rank or higher to work for several months with Schnur.

Special Studies, ECW Pruning and Thinning (Project Mt-2, Special)

This special study, conducted in cooperation with the Maryland Department of Forestry on ECW funds, will be completed by June 1. A manuscript on the pruning will be prepared for publication by Mollenhauer, and a short paper by Meyer on some volume table measurements. The establishment report on the thinning, by Schnur, although probably not warranting publication from the point of view of information already obtained, should, from that of methodology, be decidedly worth circulation among the foresters of this territory. A large acreage of plantations in the four States has reached a point where silvicultural treatment is either essential or desirable, and the Loch Raven studies may offer suggestions to many agencies. Work by the ECW at Loch Raven is almost certain of expansion.

Special Studies, ECW Virginia Pine (Project M-2, Special)

Among the 12 projects listed by the committee for coordination of research of the Advisory Council as justifying work in the near future is a study of the management of Virginia pine. This pine is well distributed through the greater part of the oak type in the Station territory, and on the western shore of Maryland is the commonest pine of the oak-pine type. It has reforested a quarter of a million acres of old fields in Pennsylvania alone. Practically unused for any purpose a few years ago, it is today in great demand for pulpwood and for a few other purposes. Although its growth and yield has been studied by both the United States Forest Service and Pennsylvania State College, its silvicultural management has not been the subject of any major investigation. The Maryland Forest Service has accumulated considerable information on Virginia pine which is nearing publication, but members of that service have themselves suggested that a wide field remains for timber stand improvement studies. Both at the NARC Branch Station in Maryland and the Stone Valley Station in Pennsylvania numerous young stands afford an opportunity for study. Pending the outcome of a survey to determine the most important problems of the oak type, as a basis for a program of long-term research at both these branches, temporary funds will be used to establish some permanent timber stand improvement plots in Virginia pine, particularly at Beltsville. A Junior Forester will be assigned to this work under the direction of Schnur, and will have the help of student assistants and Junior Assistants to Technician (ECW). The work at the NARC branch will be in close cooperation with the Maryland Department of Forestry.

Forest Planting, Birch-Beech-Maple-Hemlock (Project Fp-1)

The 4-1/2-acre site on the Kane Experimental Forest, originally prepared for planting in 1934, will be planted with Norway pine seedlings raised by the Lake States Forest Experiment Station in a study of seed source. This pine is the species most extensively used by the Allegheny National Forest in its planting of aspen-fire cherry areas. Hough will be in charge.

The Station will recommend to the Allegheny National Forest continuance of the cooperative planting study, conducted jointly by the Forest and the Station in 1936. The data obtained in the past year will perhaps yield more detailed or accurate information if subjected to greater refinement of statistical technique. Additional field work is necessary in young plantations if the cause and cure of early loss is to be discovered. As last year, the Station contribution will necessarily be largely confined to technical advice and office assistance.

Fire damage, Oak-Pine (Project Pf-3)

Damage to timber larger than reproduction will be ascertained by Wood and Little from the controlled burning plots in south Jersey. Cooperation will continue with the New Jersey Department of Conservation and Development. The Department has also interested the New Jersey Agricultural Experiment Station, which will employ an investigator on Bankhead-Jones funds to study the effect of fire on the chemical and physical condition of the soil.

Mensuration, Oak-Pine (Project ME-3)

Data obtained from the seventh remeasurement of the 13 remaining loblolly pine permanent sample plots on the Eastern Shore of Maryland will be put into such form that they can readily be punch-carded at the Washington office for further analysis.

A practicable method of applying to stand improvement work the information obtained from these plots will be described for publication by Schnur.

Some preliminary consideration will be given to a research program at the prospective Eastern Shore Branch Station, for which the sample plot data accumulated nearby since 1906 will form a very valuable background.

Mensuration, Oaks (Project ME-2)

This is now a minor project, but valuable data long in hand justify the preparation by Schnur of two brief papers, one a comparison of tree volumes, the other a comparison of rate of growth on sample plots at Camp Ockanickon in southern New Jersey.

RESEARCH IN FOREST PATHOLOGY

Forest Tree Seedling Diseases (B.P.I. Project 2P)(Dr. L. W. R. Jackson)

The main project for the year was a study of tree seedling diseases in forest nurseries, and the development of control measures. The loss of coniferous planting stock caused by damping-off and root-rot diseases has increased to a point where it has seriously reduced production at several of the forest nurseries in this region. At three nurseries it has become practically impossible to grow certain species of conifers without the use of effective soil treatments. The recent increase in forest nursery production has also increased the need for more work on tree seedling diseases. The nursery disease project was supported in part by Emergency Conservation funds.

Work of past year. Damping-off and root-rot disease control experiments were conducted in cooperation with several forest nurseries. The principal control measures tested were soil treatments with sulphuric acid, aluminum sulphate, salycilic acid, acetic acid, and formaldehyde. A study was made of the cause of the diseases and the relation of soil factors, especially soil acidity. The study also included observations on the effect of nursery practices on diseases.

Cylindrocladium sp. has become an important damping-off and root-rot parasite in certain forest nurseries in Pennsylvania, Maryland and New Jersey. During the past two years it has practically wiped out the red pine and Scotch pine plantings in the untreated beds at one nursery. The investigation of the characteristics of the disease has been completed.

Plot tests were made for the first time in the State nursery at Greenbank, New Jersey. Damping-off caused heavy losses in the untreated pitch pine beds. Soil treatments with sulphuric acid and formaldehyde effectively controlled the disease. Best results were obtained when the soil was treated with a surface application of formaldehyde and sowed 4 days later.

Plot tests were made also for the first time at the CCC nursery at Newfoundland, New Jersey. The results showed that sulphuric acid and formaldehyde effectively controlled damping-off.

Plot tests were continued at the State nursery at Mont Alto, Pennsylvania. Acidification of the soil with aluminum sulphate to a depth of six inches effectively controlled damping-off and increased production. This type of treatment was particularly effective on the alkaline soils. Large areas in this nursery have become practically unproductive on account of diseases associated with high soil pH.

The main part of the experimental work was done at the State nursery at Washington Crossing, New Jersey. A large number of plot tests were made. It was found that formaldehyde, sulphuric acid, and salycilic acid effectively

controlled damping-off.

The artificial acidification of weak acid and alkaline soils to a depth of six inches, by means of either aluminum sulphate or sulphuric acid, is a new treatment that is being tested. A laboratory method was developed to determine, by the use of small soil samples, the rate of application required to attain any desired degree of acidity at any depth. Acid requirement curves were prepared for a large number of nurseries throughout the United States.

Cooperation was extended to the Soil Conservation Service nurseries. The nursery at New Brunswick, New Jersey, was held under observation throughout the season. Information was obtained on the symptoms of lightning injury - a unique form of injury not previously described - on black locust seedlings.

Future plans. The investigation of nursery diseases will be continued as a major project on the regular funds. However, the Emergency Conservation Work support on the field service work at the forest nurseries in the region will be withdrawn April 1, 1937. It will be impossible therefore to continue the disease control experiments that were started at several of the nurseries during the past two years.

General Forest Pathology (B.P.I. Project 1P2)(Dr. L. W. R. Jackson)

A large number of general inquiries and specimens of tree diseases were handled during the year.

In cooperation with the Maryland Department of Forestry, an investigation was made of a case of red pine dying on the Baltimore watershed at Loch Raven. All of the trees in a small planting made in 1917 died out at about the same time. The data indicate that the dying was probably caused by a change in the level of the water table.

Observations were made on a case of red pine dying in the plantations on the watershed at York, Pennsylvania. The results seem to indicate that the dying was caused by drought. No cases of fungous diseases were observed. This work was done in cooperation with the Pennsylvania Department of Forests and Waters.

Field observations were continued on the plane-tree disease prevalent in the Philadelphia area. The number of trees killed by the disease increased considerably during the past year.

Decay of Sprout Hardwoods (B.P.I. Project 3P)(Dr. Bailey Sleeth, Dr. W. A. Campbell, and E. R. Roth)

This study has for the most part been confined to butt-rot in sprout-oak stands, which cover about 12,000,000 acres in the States of Delaware, Maryland, New Jersey, and Pennsylvania. Its purpose is to determine (1) the avenue of entrance of decay fungi into oak sprouts, (2) the extent of decay

present, (3) the identity of the fungus causing the decay, (4) the factors concerned with high and low decay incidence, and (5) practices necessary to keep decay losses at a minimum.

Work of Past Year. This study has been in progress for some time and work has been done both within and out of the Allegheny region. Work has been confined to the region during the past year. Six quarter-acre plots were clear cut, and each individual tree carefully examined, on the Mont Alto and Michaux State Forests of Pennsylvania, and in Garrett County, Maryland. Late in the summer 7 quarter-acre decay-transmission thinning plots were established in the Mont Alto Forest with the cooperation of the Pennsylvania State Forest Research Department. Results from these 7 plots combined with other proposed thinning plots in the Allegheny region should yield valuable information on the decay hazards that occur in thinning operations and methods that may be used to keep them as low as possible. At the end of the field season work was begun on the task of compiling the data collected during the past 3 years and preparing a manuscript for publication in bulletin form. The data is being combined with like data collected from the Appalachian region and elsewhere and will represent a joint contribution from the two regions.

A brief summary of results indicate that oak-sprout reproduction is important in the Allegheny region and that extensive losses are caused by butt-rotting fungi because of certain conditions peculiar to this type of reproduction. This is evident from the fact that over 95 per cent of the trees cut and dissected were sprouts and in some cases as high as 50 per cent of the sprouts in some plots showed decay at stump height. The sprout stands ranged from 25 to 50 years old and were free of visible fire scars. The source of decay infection was traced to the old stump in over 90 per cent of the sprouts affected with butt rot, while a cut or dead companion sprout was the source of entry in a few cases and a small number were undetermined. Of the species studied, black and scarlet oaks had the highest percentage of butt decay cases, red and white next highest, and chestnut oak the lowest. Incidence of decay was found to be associated with the size of stump from which a sprout grew, height of origin of sprout on the stump, heartwood formation, old stump wounds, age of stand, history of stand, and other conditions.

Work on the butt rots of sprout northern hardwoods included the establishment of 3 dissection plots, from 1/8 to 1/2 acre in size, on the Kane Experimental Forest.

Future plans. Plans are being made to continue the study along the following lines:

Decay in northern hardwoods.
Decay hazards that occur in sprout-thinning operations
Decay hazards that occur in pruning operations, both in plantations and natural reproduction
Decay in merchantable stands of timber, particularly in oak-stands older than those covered in the sprout decay study.

Attention is called to the fact that since late in the summer of 1933 this study has been carried on with temporary funds as a CCC project in cooperation with the Allegheny Forest Experiment Station. Although it was originally set up as a major station project and is still so considered, its active continuance after July 1st will no doubt be largely dependent upon the status of CCC after that date.

Mycorrhizae (B.P.I. Project 6 P) (Dr. K. D. Doak)

Work of past year. Progress on the various phases of this project has followed those aspects which indicate a practical application of the fundamental work completed during the past four years. Nurseries and plantations offered the starting point in such work due to the possibilities for controlling conditions and getting comparable material for growth study. Coniferous nursery stock in the Allegheny region has furnished the basic data leading to the conclusion that future developments will be concerned with the relation between mycorrhizae and pseudomycorrhizae as affected by soil conditions and ultimately influencing growth.

Through intensive study of the root development of nursery stock from various parts of the country, it has been established that poor growth is correlated with a predominance of pseudomycorrhizae. At the present time, most conclusive evidence from nurseries in the middle western and plains regions has demonstrated that this situation is due either to the absence or inactivity of mycorrhizal fungi. Inoculation experiments to determine the effects of introducing fungi previously proven capable of forming mycorrhizae were started during the past year. It was found that many of these fungi cannot be introduced into nursery soils unless conditions are changed.

Fungi isolated from typical pseudomycorrhizae have been proven capable of producing these in sterile culture. This relationship has made possible the future investigation of their influences in comparison to mycorrhizae under controlled conditions.

In decadent plantations of conifers, it has been found that predominance of pseudomycorrhizae occurs, and the relationship in this respect agrees with nursery evidence. At the present time these factors are considered secondary to soil conditions which influence them, but the fact that the mycorrhiza-pseudomycorrhiza balance is directly correlated indicates the importance of conducting inoculation work in connection with soil changes through fertilization and management and the effects of site in plantation work.

Experimental work in the laboratory has yielded several new combinations of hosts and fungi forming mycorrhizae. Culture studies of both mycorrhizal and non-mycorrhizal fungi has yielded a tentative key by which the same species can be identified by their mycelial or vegetative characters when isolated directly from mycorrhizae. The sporophore isolates making up the permanent culture collection have served as the basis of this and will facilitate rapid identifications in the future.

Several cooperative studies with the Forest Service and Botanical Department, University of Pennsylvania, have yielded results valuable to the project. Dr. H. H. York has contributed material for investigation from nurseries and plantations outside the Alleghony region, Mr. A. G. Lisi is conducting a morphological study of compound mycorrhizae of native tree species, and Miss M. Barenbaum has completed an ecological study of the relationship between sporophore production of soil Hymenomycetes in various forest types, species of trees, and mycorrhizal association. These cooperators have contributed valuable fundamental results which will be basic for future investigations.

Future plans. The concentration on some fundamental points and their immediate implications appear to justify experiments along the same line. Practical application of information already gained in this project to the problems of artificial forestation - nursery and planting practices - cannot be adequately handled with present personnel. The Allegheny territory has for years been among the leaders in artificial forestation of both public and private land, and therefore offers exceptional opportunities for such investigations as the inoculation of nursery beds with mycorrhizal fungi. The present would be a most opportune time for the Forest Service to resume its cooperation with the Bureau of Plant Industry in this project, by assigning to it a man to undertake a program of experimental nursery inoculations at representative nurseries in the four States. Hearty cooperation can be counted upon from both Federal and State agencies in this work.

Expenditures from Regular and Emergency Funds

of the

Allegheny Forest Experiment Station

Fiscal Year 1936

Research Projects and Improvements and Maintenance	Regular (continuing) Funds	Emergency (temporary) Funds				Grand Totals
		E C W	E R A	N Y A	Totals	
Fp-1 (Birch-beech-maple-hemlock)	$ 692.57	$ -	$ -	$ -	$ -	$ 692.57
Fp-3 (Oak-pine)	663.02	114.16	-	-	114.16	777.18
M-1 (Birch-beech-maple-hemlock)	10,643.07	1,466.46	7,800.21	135.25	9,401.92	20,044.99
M-2 (Oaks)	915.80	57.88	-	-	57.88	973.68
M-3 (Oak-pine)	4,951.22	4,594.21	1,481.23	-	6,075.44	11,026.66
ME-2 (Oaks)	3,768.73	-	111.24	-	111.24	3,879.97
ME-3 (Oak-pine)	1,942.54	352.42	370.50	-	722.92	2,665.46
Pf-3 (Oak-pine)	227.69	58.34	7.87	-	66.21	293.90
Miscellaneous projects	159.03	-	125.63	-	125.63	284.66
Cooperation (B. P. I.)	52.75	-	666.47	458.75	1,125.22	1,177.97
Improvements and maintenance	-	-	9,861.24	-	9,861.24	9,861.24
Totals	$24,016.42	$6,643.47	$20,424.39	$594.00	$27,661.86	$51,678.28

MANUSCRIPTS PUBLISHED

Doak, K. D.	Mycorrhizae of trees and shrubs. Bulletin of the Morris Arboretum, 1:45-49, 1936.
Forbes, R. D.	Deep in the woods. Forest Leaves, Vol. XXVII #1, January, 1937.
" "	Forests and flood control. Forest Leaves, Vol. XXVI #4, October, 1936.
Hough, A. F.	A climax forest community on East Tionesta Creek in northwestern Pennsylvania. Ecology, Vol. 17, #1, January, 1936.
" "	A study of natural tree reproduction in the beech-birch-maple-hemlock type. Journal of Forestry, Vol. 35 #4, April, 1937.
" "	Epicormic branching of Allegheny hardwoods. Technical Note #10, January 31, 1936.
" "	Estimated area of forest land in three major forest regions of the Allegheny Forest Experiment Station territory. Technical Note #11, May 21, 1936.
" "	Height growth of hemlock and hardwood seedlings in a virgin stand on East Tionesta Creek. Technical Note #12, June 1, 1936.
" "	The dying of hemlock and other species on the Allegheny National Forest. Technical Note #9, January 14, 1936.
McIntyre, L. C. and Schnur, G. Luther	Effects of drought on oak forests. Bulletin #325, March, 1936. Pennsylvania State College, State College, Pa.
McQuilkin, W. E.	Root development of pitch pine, with some comparative observations on shortleaf pine. Journal Agr. Res., Vol. 51, #11, December 1, 1935.
Morey, H. F.	A comparison of two virgin forests in northwestern Pennsylvania. Ecology, Vol. 17, #1, January, 1936.
" "	Age-size relationships of Hearts Content, a virgin forest in northwestern Pennsylvania. Ecology, Vol. 17 #2, April, 1936.

MANUSCRIPTS PUBLISHED (Continued)

Simmons, E. M. and Schnur, G. Luther	Effect of stand density on mortality and growth of loblolly pine. Journal of Agric. Res., Vol. 54, #1, January 1, 1937.
Sleeth, Bailey	Recommendations for keeping the decay hazard at a minimum in silvicultural cuttings in Connecticut sprout hardwood stands. Mimeographed.
Wood, O. M.	Early survival of some pine interplantings in southern New Jersey. Journal of Forestry, Vol. XXXIV, #9, September, 1936.
" "	First year losses after a fire may not represent total mortality. Technical note #13, May 29, 1936.

MANUSCRIPTS SUBMITTED

Downs, A. A.	Weather conditions during the glaze storm of March 17-19, 1936, in Pennsylvania and New York State. Monthly Weather Review.
Forbes, R. D.	Federal forest research in Maryland. Forests and Forestry in Maryland. Maryland Development Bureau.
" "	"Mikes" Scientific Monthly
Hough, A. F.	A study of natural tree reproduction in the beech-birch-maple-hemlock type. Journal of Forestry.
Jackson, L. W. R. and Bailey Sleeth	A disease killing the plane trees. Forest Leaves.
Wood, O. M.	The interception of precipitation in an oak-pine forest. Ecology.

MANUSCRIPTS PROPOSED FOR THE FISCAL YEAR 1938

(Arranged in order of probable completion)

Author	Subject	Form of Publication
Hough, A. F.	Why timber stand improvement?	Journal of Forestry
Downs, A. A.	Glaze damage in northern hardwood-hemlock.	" " "
Wood, O. M.	Factors affecting seed production, seed germination, and seedling survival of oak in southern New Jersey.	Ecology
Hough, A. F.	Silvicultural methods of stand improvement in northern hardwoods-hemlock.	Journal of Forestry
Ostrom, C. E.	After second growth - what?	" " "
Meyer, E. F.	Some tree volumes in planted stands.	" " "
Little, S.	Number and vigor of sprouts following partial and clear cuttings in sprout hardwood stands.	" " "
Mollenhauer, Wm. Jr.	A study of pruning tools and technique.	" " "
Schnur, G. L.	A working plan for a study of thinning in planted stands.	Mimeographed.
Schnur, G. L.	Comparisons between volumes of tree of different species in one locality and of like species in different localities.	Journal of Forestry
Schnur, G. L.	Some practical aids to stand improvement in loblolly pine.	ECW or Maryland Forestry Dept. pub.
Schnur, G. L.	Comparative growth increments in oak stands with and without brush removal.	Journal of Forestry
Wood, O. M.	What part of old root system is retained by sprouts that follow cutting of parent tree?	" " "

Manuscripts Proposed - Continued

Author	Subject	Form of Publication
Little, S.	Persistence of sprouts with increasing age in sprout hardwood stands.	Technical Note (mimeographed)
Wood, O. M.	Soil temperature in woods and in open areas, south Jersey.	Ecology
Forbes, R. D. and Hough, A. F.	The virgin forests of the northern Allegheny Plateau.	Ecological Monographs
Schnur, G. L. and Mollenhauer, Wm. Jr.	Forest fires in New Jersey, 1931-1935.	U.S.D.A. Circular
Wood, O. M. and Little, S.	Effect of seed bed treatment on reproduction of pine in southern New Jersey.	Journal of Forestry
Wood, O. M. and Little, S.	Damage to oak-pine stands by controlled burning.	" " "
Little, S.	The fall of shortleaf pine seed in south Jersey.	Technical Note (Mimeographed)
Hough, A. F.	Progress report on methods-of-cutting studies.	Journal of Forestry

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MANUSCRIPTS PROPOSED FOR THE FISCAL YEAR 1939

Staff	Timber growing for wood, recreation, and water in the Allegheny region. 100 pages	Dept. Agr. Bul.
Staff	The Allegheny Forest Experiment Station and its work, 1928-1938. 25 pages.	Dept. Agr. Circ.

MANUSCRIPTS PROPOSED - B. P. I.

Author	Subject	Form of Publication
Doak, K. D.	Relation of sporophore production and mycorrhizal associations of soil Hymenomycetes and Gasteromycetes.	Ecology
Jackson, L. W. R.	A survey of soil pH and seedling diseases at the Greenwood Furnace nursery.	
" "	Lightening injures black locust seedlings.	
" "	Poor growth of black locust seedlings at Mont Alto nursery related to high soil pH.	
" "	The acid requirement method.	
" "	The Cylindrocladium disease of conifer tree seedlings.	
" "	The effect of acid treatments on soil pH.	
" "	Winter injury disease of boxwood.	Phytopathology
Jackson, L. W. R. and Kaplan, Frank	Dodder damages black locust seedlings.	Journal of Forestry
" "	Deep acidification with aluminum sulphate controlled damping off at the Mont Alto nursery.	
" "	Heavy damping off related to high soil pH at a Pennsylvania nursery.	
" "	Results from the 1935 damping off control experiments at Mont Alto, Pennsylvania.	
" "	Results from the 1936 damping off control experiments at Washington Crossing, New Jersey.	
" "	Results from damping off control experiments at Newfoundland, New Jersey.	

MANUSCRIPTS PROPOSED - B. P. I. (Continued)

Author	Subject	Form of Publication
Jackson, L. W. R. and Kaplan, Frank	Results from damping off control experiments at Greenbank, New Jersey.	
Jackson, L. W. R. and Wean, Robert	Rhizoctonia root rot of tulip poplar seedlings.	Phytopathology
Wean, Robert, and Jackson, L. W. R.	Results from the 1935 damping off control experiment at Washington Crossing, New Jersey.	

MANUSCRIPTS PROPOSED - B. P. I.

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Doak, K. D.	Relation of sporophore production and mycorrhizal associations of soil Hymenomycetes and Gasteromycetes.	Ecology
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Wean, Robert, and Jackson, L. W. R.	Results from the 1935 damping off control experiment at Washington Crossing, New Jersey.	